## CLAIMS

What is claimed is:

1. A method for forming a localized halo structure in a semiconductor substrate of a semiconductor device, comprising:

providing a gate structure over the semiconductor substrate;

implanting a dopant material at an angle around the gate structure to form a halo structure in a source/drain region of the semiconductor substrate and underlying a portion of the gate structure;

forming a trench in the source/drain region of the semiconductor substrate, thereby removing at least a portion of the halo structure in the source/drain region; and

forming a semiconductor material layer in the trench using epitaxial deposition.

2. The method of claim 1, wherein the semiconductor material layer comprises silicon.

3. The method of claim 1, wherein forming the semiconductor material layer comprises:

forming an intrinsic silicon layer in a bottom portion of the trench; and

forming a doped silicon layer in a top portion of the trench overlying the intrinsic silicon layer, wherein the trench is substantially filled having a generally undoped region in a bottom portion of the trench and a generally doped region in a top portion of the trench.

4. The method of claim 3, further comprising:

thermally processing the device;

forming a spacer on lateral sidewalls of the gate structure; and

performing a source/drain implant into the semiconductor material layer in the trench to form a source and drain region.

5. The method of claim 4, wherein the trench has a depth, and wherein the source and drain region have a depth which is less than the trench depth.

6. The method of claim 4, wherein thermally processing the device comprises rapid thermal annealing to slightly grade a junction formed between the undoped silicon material layer and the doped silicon material layer in the trench.

7. The method of claim 1, wherein the forming the semiconductor material layer in the trench using the epitaxial deposition comprises filling substantially the entire trench with silicon or SiGe.

8. The method of claim 7, further comprising:

implanting an HDD dopant into a top portion of the silicon or SiGe in the trench.

9. The method of claim 8, further comprising:

thermally processing the device;

forming a spacer on lateral sidewalls of the gate structure; and

performing a source/drain implant into the silicon material layer to form a source and drain region having a depth that is less than a depth of the trench.

10. The method of claim 1, wherein forming the trench comprises etching the semiconductor substrate in the source/drain region in a substantially anisotropic manner.

11. The method of claim 1, further comprising cleaning the device after the formation of the trench.

12. The method of claim 3, wherein a thickness of the intrinsic silicon layer is greater than a thickness of the doped silicon layer.

13. The method of claim 3, wherein the doped silicon material layer comprises one of Si doped with As, SiGe doped with As, Si doped with B and SiGe doped with and B.

14. A method for forming a localized halo structure in a semiconductor substrate of a semiconductor device, comprising:

providing a gate structure over the semiconductor substrate;

implanting a dopant material at an angle around the gate structure to form a halo structure in a source/drain region of the semiconductor substrate and underlying a portion of the gate structure;

forming a trench in the source/drain region of the semiconductor substrate, thereby removing at least a portion of the halo structure in the source/drain region; and

forming a silicon material layer in the trench using epitaxial deposition, wherein forming the semiconductor material layer comprises:

forming an undoped silicon material in a bottom portion of the trench; and

forming a doped silicon material in a top portion of the trench overlying the undoped silicon material.

15. The method of claim 14, wherein the doped silicon material in the top portion of the trench is doped in-situ during the epitaxial deposition.

16. The method of claim 14, wherein the doped silicon material in the top portion of the trench is doped after the epitaxial deposition via ion implantation.